



HOW IS AI USED IN DENTISTRY?



AzDA MEMBER DENTIST
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No doubt everyone in the dental profession has heard about AI. There has been a lot of hype in the media about AI. Dentistry is not practiced in a vacuum, and it is very much affected by advancements in computer technology, as all fields are. AI is currently only used by “early adopters,” but eventually it will be embraced by all dental professionals. The most popular platform today is the Generative AI program ChatGPT. Interestingly, ChatGPT has enjoyed much faster implementation than Instagram or TikTok¹. It is currently accessible to all in a basic free version.

There is a myriad of other AI applications for use in Dentistry. ChatGPT was asked to report on how AI is currently being used in the dental profession, and it returned a detailed, though not complete, answer.²

The following AI applications are currently available or being explored for use in dentistry:

Administrative tasks at the front office:

“Any task that has to do with data processing and anything that’s routine, AI will excel at,” says Kelly Monahan,

managing director of Upwork Research Institute.³ AI can automate various administrative tasks, saving time and improving efficiency. Erik Brynjolfsson, along with researchers Danielle Li and Linsey Raymond, conducted a study of 5,000 customer support agents at a call center who were using generative AI. The AI tools were found to boost worker’s productivity, reduce attrition, and greatly assist early-career workers. ChatGPT says that by leveraging AI for administrative tasks, dental practices can reduce manual workloads, minimize errors, improve patient satisfaction, and focus more on delivering quality patient care.

- a. *Appointment scheduling:* AI-powered scheduling software can manage appointment booking, rescheduling, and cancellations. It can also send automated appointment reminders to patients via text or email.
- b. *Patient registration:* AI chatbots or virtual assistants can handle patient registration processes, including gathering patient information, insurance details, and medical history.
- c. *Insurance verification:* AI tools can streamline insurance verification processes by automatically verifying patient insurance coverage and eligibility.
- d. *Billing and payments:* AI systems can generate and send electronic invoices, process payments, and manage billing inquiries. They can also assist in claims processing and follow-ups.

- e. *Patient communication:* AI chat-bots can handle patient inquiries, appointment confirmations, and follow-ups, providing 24/7 support and improved communication efficiency.
- f. *Data entry and record management:* AI software can automate data entry tasks, update patient records, and ensure data accuracy and consistency across systems.

Imaging & image interpretation:

Image interpretation has always involved subjectivity. Dentists often do not agree when interpreting radiographs. The Pearl Company, which specializes in reading and analyzing dental x-rays, estimates from studies that 43% of caries in dental X-rays are undiagnosed, 20% of decay is misdiagnosed, and between 24% and 39% of calculus, margin discrepancies and periapical radiolucencies are completely overlooked.

AI has the power to see subtle differences that human eyes cannot. In a greyscale 2-D radiograph, each pixel has an intensity (brightness) that represents its density. The AI algorithm can detect density patterns and make comparisons with thousands of similar patient x-rays to make accurate predictions through Machine Learning or “ML”.³ The Pearl Company’s research demonstrates that “computer vision is proficient and often superior” to human vision.⁴ Pearl scientists estimate that AI’s radiographic examination can actually detect 37% more disease than dental practitioners.

ChatGPT emphasized that Pearl’s dental image analysis can provide insight into dental conditions and abnormalities. Another program called Overjet (overjet.ai/about-overjet) is focused on identifying dental issues “like cavities, fractures and bone loss.” Both tools, says ChatGPT, “can be valuable for dentists to improve diagnostic accuracy and treatment planning.” There are other tools like CariVu and Denti.AI that also detect and diagnose dental disease through AI image analysis.

Diagnosis and treatment planning:

AI is currently being used in medicine for diagnosis. Dr. Erik Topol, a practicing cardiologist at the Scripps Clinic and author of, *Deep Medicine: How Artificial Intelligence can make Health Care Human Again*, believes that Google Searches and WebMD are not that good for diagnosis, but that ChatGPT is going to become a more refined way of getting answers to questions. AI has a tremendous advantage over individual physicians—the ability to analyze massive amounts of data—far more than human experts could ever manage. As a result, AI can see patterns that humans cannot.

Dr. Topol cited a case where a patient went to seven neurologists who diagnosed her with “Long COVID.” The treatments for “Long COVID” did not help her. Her sister plugged her symptoms into ChatGPT and its diagnosis was “Limbic Encephalitis.” She was treated for this condition and cured.⁵

However, treatment planning for dental conditions cannot be applied in the same way as it is applied to medicine. Most dentists do not have

enough treatment options to offer patients, and they are not aware of treatment options that could be offered to patients. The internet is full of misinformation in this area, and a lot of information comes from biased sources such as product manufacturers who are more concerned about selling products than the welfare of patients. Left on its own to scour the internet, AI is almost certain to come up with wrong answers. For AI to be effective as a diagnostic and treatment planning tool, it will have to be programmed by dental experts so it can return the *right* answers.

Most restorative dentists are currently trained to think in a piecemeal way; that is, to fill a hole or a space. However, treatment planning should be exercised with an overall approach to patient care—one that considers the overall health of the patient and what can be done to prevent future problems. An overall approach requires critical thinking skills as well as an armamentarium of treatment options that can be offered. Patients are individuals and it is important to choose the treatment option that is truly best for each patient. Patients should also have choices, and most dentists lack the ability to offer them.





If AI is going to be useful in treatment planning, it will have to be programmed to ensure that treatment options are offered that have a real track record and it will have to direct dentists as to where they can receive the appropriate training.

Currently, AI directed digital algorithms can assist with smile design—visualizing and displaying ideal treatment outcomes. Digital manipulation in this manner is quite impressive when presented to patients. But patients expect an identical outcome to the digital presentation. The actual outcome may be different from what was originally envisioned, resulting in disappointed patients. The digital algorithms only deliver a potential esthetic outcome and do not consider complications that might arise, overall periodontal health and the prevention of future problems.

Dental Specialties:

a. *Periodontology:* AI is being investigated as a tool for diagnosing

periodontitis and classifying types of periodontal diseases. A periodontal disease diagnosis is currently based on evaluating pocket depths and gingival recession, with the Periodontal Screening Index (PSI) quantifying attachment loss. Hao Ding et al. noted that the clinical evaluation of periodontal disease has low reliability because it is subjectively based on the clinician's experience.⁶

b. *Oral pathology:* ChatGPT reports that there is ongoing AI research for the development of AI algorithms for early detection of oral diseases, such as oral cancer. Pathologic diagnosis is definitively determined from tedious examination of stained biopsy specimens on glass slides under a microscope and with radiographs. Many benign conditions also mimic malignant ones in clinical appearance. Hao Ding et al. report that only 20% of biopsies are actually malignant. AI can greatly assist in preventing the terrible consequences that can arise from misdiagnosis.⁷

c. *Orthodontics:* Orthodontic treatment planning is usually based on the experience and preference of the orthodontists. Every patient is unique, so the treatment plan must be custom-tailored to each individual. ChatGPT reports that an AI program called Dentem uses AI to analyze patient data and provide personalized treatment recommendations. Many variables, explains Hao Ding and his team of doctors, have to be considered in the diagnosis of malocclusions.⁸ AI is an ideal tool for solving orthodontic problems. They point out that "the skeletal patterns and anatomic landmarks in lateral cephalograms can be clearly seen with the aid of AI algorithms." AI models can also evaluate data from cephalometric images, CBCT scans, and intraoral scans to determine requirements for ideal orthodontic treatment. These models can also suggest the best sites to segment the alveolar bone in orthognathic cases. Chat GPT reports that there

are AI-powered solutions to track the progress of orthodontic treatments and recommend adjustments as needed.

AI models can be used to predict growth and development patterns in humans, and these predictions can have significant implications for orthodontic treatment planning. AI algorithms can analyze dental and facial images to predict how a patient's teeth and jaw structures will change over time. AI models can also evaluate factors such as skeletal maturity, dental eruption patterns, and facial proportions to predict optimal timing for such orthodontic interventions as braces or aligners. "By leveraging AI-driven predictive modeling, dentists can optimize treatment outcomes and reduce the need for complex interventions in the future," says ChatGPT.

- d. *Pediatric dentistry:* AI can aid in predicting the eruption sequence of primary and permanent teeth, guiding dentists in managing dental development and preventing overcrowding or early tooth loss.
- e. *Prosthodontics:* AI is focused on improving the accuracy and efficiency of CAD/CAM systems. Intraoral scanning has proven to be accurate for fabricating models, inlays and onlays, orthodontic aligners, bleaching trays, and mouthguards.

However, intraoral scanning is confined to tooth structure above the gingiva and is therefore not appropriate for creating crowns and bridges, even though it is commonly used for this purpose. It has been reported that AI is not yet able to achieve individual custom digital designs for crown and bridgework.⁹ ChatGPT reports that researchers are currently working on AI algorithms that can detect and correct errors in prosthetic designs, ensuring optimal fit and functionality.

The mainstream digital approach to full coverage restorations is not based on the sound principles of science and

engineering that came from dentistry's "roots." The incredible track record from dentistry's roots has been abandoned in favor of shortcuts and "workflow." Restorations made from digital intraoral scans are not accurate for crowns and bridges and, in fact, open the door to recurrent decay and loss of retention. It has been rumored that a special scanner for registering the entire root surface below the gingiva will soon hit the marketplace. Such a device would be a real game changer. Already available is a miniature fiberoptic camera that can directly view the subgingival periodontal crevice. Some offices in Arizona are currently using this technology to thoroughly scale the root surface without surgical flapping.

However, desktop scans of analog models made with non-removable dies in the "analog" laboratory are quite accurate and milled restorations can be designed on the computer from these scans and then fabricated with high tech milling machines. The Strategy Milling Company in Pittsburgh, PA¹⁰ is at the forefront of milling precious metals. This company mills highly accurate crowns and bridges that rival or exceed the accuracy of cast restorations. The milling of denture bases has also been proven to be far more accurate than conventional heat and pressure denture bases, which almost always result in inaccuracies of fit, occlusion, or tooth position. ChatGPT reports that AI research is currently being conducted for the enhancement of "longevity and durability of dental prostheses by predicting wear and tear patterns and recommending maintenance strategies."

Patient comfort and education:

ChatGPT notes that AI applications exist that can improve patient experience and treatment outcomes. Virtual reality tools, powered by AI, can help patients relax and feel more comfortable during dental procedures. AI-driven educational apps and games can promote ideal oral hygiene habits and raise the dental IQ of young patients.

DENTAL PRACTICES FOR SALE

Prescott Area	\$1,895,000
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Forensic Dentistry:

AI is currently being used in forensic dentistry and is particularly useful in identifying victims of mass disasters. It can efficiently cross-reference large databases and find matches. In addition to matching restoration patterns, AI can examine and compare measurements of the jaws and teeth in the quest for identification. Dr. Kenneth Aschheim, a forensic expert who recently presented at AzDA's WRDE, explains that "Integrating AI promises to enhance the speed and precision of dental evidence analysis, benefiting criminal investigations, victim identification, age estimation and legal proceedings."¹¹

Even though a robot has already been invented to prepare, fabricate and insert a [substandard] crown on its own¹², AI must never be allowed to replace dentists. AI should be treated as a useful tool and nothing more. As Kelly Mo-nahan, Managing Director of Upwork Research Institute, explains, "Critical skills, strategic thinking, emotional intelligence, and creativity simply can't be programmed. At its best, AI augments human potential—it's not a substitute."¹³

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2 ChatGPT was asked how AI is being used in Dentistry. This section includes ChatGPT responses to this question.

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5 Shah,Simmons (with additional reporting from Linda Marsa); *Time Magazine Special Edition*; Spring 2024; "How to Make AI Work for You"; p. 34-39. (updated excerpt from *Time*, Aug 9, 2023).

6 Hao Ding, Jiamin Wu, Wuyuan Zhao, Jukka P. Matinlinna, Michael F. Burrow and James K.H. Tsoi (University of Hong Kong); "Artificial Intelligence in Dentistry—A Review;" *Frontiers in Dental Medicine*; February 20, 2023; p. 5-6.

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10 Strategy Milling Company in Pittsburgh, PA is at the forefront of milling precious metals. [60 Leetsdale Industrial Drive; Leetsdale, PA 15056; 724-266-3467; strategymilling.com]

11 Brandon Veremis, DDS; Aschheim, Kenneth DDS, Khare, Parul MDS, Msc FO; "Dentistry Transformed: A Brief Overview of Artificial Intelligence's Role in Dental Care;" *Role in Dental Care*;" *The New York State Dental Journal*; Vol. 90, No. 1; January, 2024; commons.ada.org/cgi/viewcontent.cgi?article=1080&context=nysdj

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Dr. Feinberg serves as Chairman of Prosthodontics for the Dental AI Association, CADS Treasurer; AzDA Council on CE and Events, AADEJ Vice-President, and Executive Director of the ONWARD program (theONWARDprogram.com)



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